

Remarks

Claims 1-43 are pending. Reconsideration and reexamination are respectfully requested in view of the following remarks.

The rejection of claims 1-43 under 35 U.S.C. §103(a) as obvious over Riebel in combination with Young is respectfully traversed. Riebel discloses a fiber-reinforced protein-based biocomposite particulate material containing a legume-based thermosetting resin and cellulosic material, and rigid biocomposite pressure-formed materials produced therefrom. Abstract.

Riebel does not teach or suggest “mixing a protein hydrolysate with a synthetic resin . . . to produce a resin binder” and “mixing the resin binder with a cellulosic material to form a cellulosic material/resin binder blend” as in claims 1 or 42. Although Riebel uses both a legume-based resin and a secondary thermosetting binder in some embodiments, the legume-based resin and the secondary thermosetting binder are not mixed together. Rather, the *legume-based resin* is prepared and combined with *cellulosic material* having a moisture content of about 55-75%, the particles are dried, and fused into a rigid pressure-formed material by pressing the dry biocomposite. If a secondary thermosetting resin is to be included, the *dried particles* of the legume-based resin and the cellulosic material are coated with *secondary thermosetting binder* prior to being fused.

According to the Office Action, “Riebel et al does teach mixing a protein hydrolysate with a synthetic resin (see col. 11, line 64 to col. 12, line 17; col. 15, lines 15-20; col. 16, lines 39-51 of Riebel et al).” However, none of these citations describes combining the legume-based resin with the secondary thermosetting binder.

For example, col. 11, lines 64 to col. 12, line 17 recites:

The legume-based resin and cellulosic material are combined in a manner to form the high moisture-content particulate material described above. Upon drying, the particulate materials can be stored for an indefinite period of time before being formed into the pressure-formed products. The particulate material can be formed into rigid materials under elevated pressures and temperatures. This can be done without any additional thermosetting binders other than the legume-based resin itself.

For particularly advantageous results *the dry particulate material is preferably coated with a secondary thermosetting binder*, such as an isocyanate, phenolic, melamine, or urea-containing binder. Preferably, the secondary thermosetting binder is an organic isocyanate,

and more preferably an aromatic isocyanate. The isocyanate provides greater mechanical properties, e.g., stiffness and strength, to the pressure-formed products. For example, it decreases the amount of cupping and warping of the pressure-formed material. As shown in Examples 7 and 8, the use of isocyanate can increase the modulus of elasticity by about 30-40% and the modulus of rupture by about 60-70%.

Col. 15, lines 15-20 describes the method of making the legume-based resin.

The protein-based resin, i.e., biocomposite thermosetting matrix material or adhesive binder, is separately prepared in stage 2 by mixing the processed soybean derivative, i.e., ground soybeans, which can be in the form of a meal or flour, preferably a flour, with a highly alkaline aqueous solution.

Col. 16, lines 39-51 discusses mixing the legume-based resin with the cellulosic material.

Upon combining the resin, which is at a pH of about 10-14, with the cellulose, e.g., paper, the pH generally drops by at least about 1 pH unit, preferably to less than about 11, more preferably to less than about 10, and typically to a range of about 7-10. Although the inventors do not wish to be held to any particular theory, it is believed that the alkaline resin causes the protein molecules to hydrolyze and open, i.e., unfold. As the cellulose becomes intermingled with the protein molecules and the pH lowers, a linking between the cellulose and protein occurs, which is believed to occur through both mechanical and chemical interactions. This is believed to be a significant contributing factor to the internal bond strength within the particles.

None of these citations shows mixing the legume-based resin with the secondary thermosetting binder. Rather, they show mixing the legume-based resin with the cellulose.

Riebel teaches that the dried particulate formed by mixing the legume-based resin with the cellulose is coated with the secondary thermosetting resin.

These methods involve: preparing an aqueous legume-based resin having a pH of about 10-14, preferably containing a colorant; and *combining a fibrous cellulosic material with the legume-based resin* in an amount and manner effective to form discrete biocomposite particles having a moisture content of about 55-75%, a particle size of no greater than about 0.5 inch (1.3 cm), and a ratio of cellulose solids to resin solids of about 0.8:10 to 1.5:1.0. These particles, preferably having a moisture content of less than about 20%, can then be

fused into a rigid pressure-formed material by pressing the dry biocomposite particles under an elevated temperature and pressure, preferably a temperature of about 250°-340°F. (121°-171°C), and a temperature of about 450-750 psi. In particularly preferred embodiments, the *dried particles are coated, e.g., spray-coated, with the secondary thermosetting binder* prior to fusing the particles into a rigid biocomposite pressure-formed material.

Col. 3, lines 47-64.

Prior to compressing the particulate material, it is preferably and advantageously coated with a secondary thermosetting binder, i.e., an aromatic isocyanate, a sizing agent for water repellency, or a combinations thereof. This can be accomplished by blending the dry biocomposite particles with the secondary thermosetting binder and/or sizing agent using a blender, such as a continuous or batch-type ribbon blender or a batch-type or continuous drum blender and coating, preferably spray coating using high pressure pumps, air atomizers, mechanical atomizers (e.g., a spinning disc atomizer), or a combination thereof. The secondary thermosetting binder interacts with the dried particles containing a protein-based resin that has been at least partially cured in the drying step of the process. This creates a dual resin system, i.e., a partially cured protein-based resin and an isocyanate resin, which is believed to provide greater advantage than either used alone.

Col. 19, lines 31-47. See also, col. 14, lines 21-34, Tables I, V, VI, Examples 7 and 8, and Figs. 3 and 4.

Prior art references must be considered in their entirety, i.e., as a whole, including portions that would lead away from the claimed invention. MPEP 2141.02 and 2145. Riebel teaches away from mixing the secondary thermosetting resin with the legume-based resin.

As discussed in Example 8 below, control of the moisture content of the particles is particularly important when an isocyanate is used. For example, if MDI is added to the wet particles, *through addition to the resin prior to addition of the cellulose, no significant advantage is realized in the mechanical properties of the resultant pressure-formed products.* However, if the MDI is added to the particles that are dried to a moisture content of less than about 20%, preferably less than about 15%, more preferably less than about 12% (often about 3-12%), and most preferably about 6-8%, significant advantage is realized in mechanical properties as well as physical properties.

Col. 12, lines 56-67.

Thus, Riebel does not teach or suggest “mixing a protein hydrolysate with a synthetic resin . . . to produce a resin binder” and “mixing the resin binder with a cellulosic material to form a cellulosic material/resin binder blend” as in claims 1 or 42.

Young is cited as teaching the step of felting. Young does not remedy the deficiencies of Riebel.

Therefore, claims 1-43 would not have been obvious to one having ordinary skill in the art at the time the invention was made over Riebel in combination with Young.

Conclusion

Applicants respectfully submit that, in view of the above remarks, the application is in condition for allowance. The Examiner is encouraged to contact the undersigned to resolve efficiently any formal matters or to discuss any aspects of the application or of this response. Otherwise, early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
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